Quarkonia at the LHC

Spencer Klein and Ramona Vogt

Charmonium and bottomonium will be produced copiously in heavy ion collisions. These quarkonia states can be dissociated in dense environments. The medium produced in heavy ion collisions can thus be probed by measuring quarkonia production as a function of impact parameter (collision centrality) and transverse momentum p_T; the absorption decreases as p_T rises because the quarkonia spends less time in the medium.

We have studied quarkonia production by lead beams at the LHC and by gold beams at RHIC with several different assumptions[1]. We compared two models of quarkonia production, the color evaporation model using the MRST LO parton densities and nonrelativistic QCD (NRQCD) using the CTEQ 3L parton densities. Nuclear shadowing, was also taken into account with three different parameterizations of homogeneous, or impact-parameter independent, shadowing.

We also considered two inhomogeneous shadowing models. The first, proportional to the local density, $S_{\rm WS}$, is appropriate for well localized interactions with formation length $l_f \ll R_A$, corresponding to $x \gg 1/2m_nR_A$. The second, appropriate for large formation lengths $l_f > R_A$, is proportional to the integrated density along the incident parton trajectory, S_ρ. The inhomogeneous models are normalized to match the homogeneous results when averaged over impact parameter. Both give very similar results. Since it is difficult to combine these two regimes in one parameterization while conserving momentum and baryon number, we present results with $S_{\rm WS}$. Including the inhomogeneity of shadowing causes naive geometrical scalings of the production cross section to fail.

Figure 1 shows the relative cross section for Υ production in NRQCD as a function of impact parameter with homogeneous and inhomogeneous shadowing. The spatially dependent models predict a very different scaling from the homogenous shadowing models.

Due to the uncertainties in both production and absorption, it is necessary to compare results with different charmonium and bottomonium mesons at LHC and RHIC[2]. Only by comparing the p_T spectra of different states [3] (and open charm and bottom) will it be possible to separate production and absorption effects.

References

[1] V. Emel'yanov, A. Khodinov, S. Klein and R. Vogt, Phys. Rev. **C61**, 044904 (2000).

[2] S. Klein, "Quarkonia at the LHC," presented at the "LHC-USA" Workshop, Dec. 20, 2000, LBNL.

[3] J.F. Gunion and R. Vogt, Nucl. Phys. **B492**, 301 (1997).

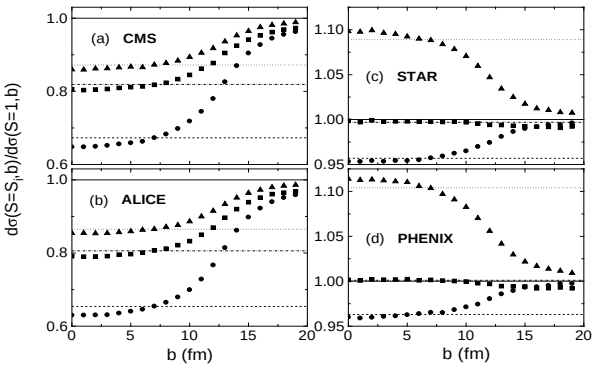

Figure 1: The impact parameter dependence of Υ production in the NRQCD model using the CTEQ 3L parton distributions. Results are shown for four detector acceptances with homogenous (lines) and inhomogenous, $S_{\rm WS}$ (symbols) shadowing.